



FCI/65 2002/005247
Rec'd PCT TO 07 SEP 2004

10/506884

INVESTOR IN PEOPLE

REC'D 30 JAN 2003

WIPO

PCT

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

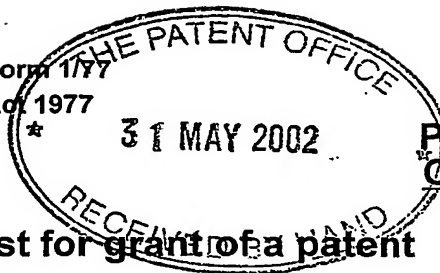
PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH
RULE 17.1(a) OR (b)

Signed

Dated 8 January 2003

BEST AVAILABLE COPY

Patents Form 1/77
Patents Act 1977
(Rule 16)



The
Patent
Office

05JUN02 E723134-5 002917
P01/7700 0.00-0212699.3

Request for grant of a patent

The Patent Office
Cardiff Road
Newport
South Wales NP10 8QQ

1. Your reference
1878801/AM
2. Patent Application Number
0212699.3
31 MAY 2002
3. Full name, address and postcode of the or of each applicant (underline all surnames)

Synaptics (UK) Limited
7340 Cambridge Research Park
Ely Road
Waterbeach
Cambridgeshire
CB5 9TB

Patents ADP number (if known) 7866809003 #J

If the applicant is a corporate body, give the country/state of its incorporation
Country: ENGLAND
State:
4. Title of the invention
SENSOR BOARD WITH FEET
5. Name of agent
Beresford & Co

"Address for Service" in the United Kingdom to which all correspondence should be sent
2/5 Warwick Court
High Holborn
London WC1R 5DH

Patents ADP number
6. Priority details

Country	Priority application number	Date of filing
---------	-----------------------------	----------------

Patents Form 1/77

7. If this application is divided or otherwise derived from an earlier UK application give details

Number of earlier application

Date of filing

8. Is a statement of inventorship and or right to grant of a patent required in support of this request?

YES

9. Enter the number of sheets for any of the following items you are filing with this form.

Continuation sheets of this form

Description

4

Claim(s)

Abstract

Drawing(s)

13 or 13

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and
right to grant of a patent (*Patents form 7/77*)

1 + 1 COPY

Request for preliminary examination
and search (*Patents Form 9/77*)

Request for Substantive Examination
(*Patents Form 10/77*)

Any other documents
(*please specify*)

11. I/We request the grant of a patent on the basis of this application

Signature

Beresford & Co
BERESFORD & Co

Date 31 May 2002

12. Name and daytime telephone number of
person to contact in the United Kingdom

ALAN JOHN SHAW MACDOUGALL

Tel: 020 7831 2290

Sensor Board with Feet

1 FILING INFORMATION

This document references the following other patent filings, the contents of which are incorporated by reference herein:

Number	Assignee	Reference
GB 95/01095	Synaptics	Spiral I
GB 98/01759	Synaptics	Spiral 3D
WO 01/29759	Synaptics	Excitation Drive Technique
WO 00/33244	Synaptics	PDA Spiral System
GB0112332.2	Synaptics	New application 21 May 2001
GB0205116.7	Synaptics	Position Sensor
Filed GB 28 May 2002	Synaptics	Two Dimensional Conductor Pattern for Inductive Position Sensor

2 INTRODUCTION

This patent is for inductive position sensing of an object above a two-dimensional sensor board, for example for pen input to computing devices. It has particular advantages for pen input to communications devices, particularly small, low-cost ones, for example personal digital assistants (PDAs), mobile telephones, Internet browsers and combinations of these.

A simplified sensing coil layout of a prior art system is illustrated in figure 1. Individual coils are illustrated in figures 2 to 5. There are four sensing coils whose coupling factor to a moving coil vary with sine and cosine dependence on either the x or y position of the moving coil:

$$K \sin X = Kx \cdot \sin \left[\frac{2 \cdot \pi \cdot x}{Lx} \right]$$

$$K \cos X = Kx \cdot \cos \left[\frac{2 \cdot \pi \cdot x}{Lx} \right]$$

$$K \sin Y = Ky \cdot \sin \left[\frac{2 \cdot \pi \cdot y}{Ly} \right]$$

$$K \cos Y = Ky \cdot \cos \left[\frac{2 \cdot \pi \cdot y}{Ly} \right]$$

An electronic sensing system, for example the one illustrated in WO 00/33244, makes an estimate of the relative magnitude and signs of $K \sin X$, $K \cos X$, $K \sin Y$ and $K \cos Y$ and uses these values to determine X and Y position:

$$X = Lx \cdot a \tan 2[K \cos X, K \sin X]$$

$$Y = Ly \cdot a \tan 2[K \cos Y, K \sin Y]$$

In a practical system, each sensor coil typically has several turns in order to improve accuracy and increase the EMFs induced by an energised moving coil, thus improving signal to noise ratio and hence power efficiency. However, when a resonator is near the perimeter of the sensor board its coupling to the sensor coils is reduced significantly relative to central positions.

A consequence of multiple turns for each coil is to increase the coupling to any nearby inductive emitter, for example a display and its drivers. This increases the noise level.

An increase in the number of turns can therefore increase signal level across the sensor board, but also results in increased noise. An objective of the invention described in this document is to improve the worst case signal to noise ratio.

A further objective of the new invention is to improve accuracy near the sensor board perimeter and especially the corners.

3 DESCRIPTION

Figures 6, 7, 8 and 9 show the conductor positions of the $\cos X$, $\sin X$, $\cos Y$ $\sin Y$ sensing coils respectively. For each plot, greyed conductors are part of each coil but are not built on the same PCB layer as the bold conductors. Greyed vias share the same layer as the conductors shown in bold but connect other coils.

Figures 10, 11, 12 and 13 illustrate the four PCB layers of the sensor board which implements the coil patterns of figures 6 to 9. In addition there are two turns of the excitation coil on each of the four layers.

Signal levels have been boosted at the perimeter of the sensor board and especially the corners. In the case of the $\cos X$ coil illustrated in figure 6 two different approaches have yielded this improvement.

Firstly, the conductors comprising the leftmost and rightmost sections of the coil bulge inwards at the top and bottom, so that the x extent of the enclosed area is greatest at the top and bottom.

Secondly, the conductors comprising the centre section make additional turns around the top and bottom of the sensor board.

Both of these modifications to the prior art increase the mutual inductance between sensor coils and moving resonator near the sensor board perimeter and especially the sensor board corners, and minimum signal EMFs are therefore increased. Furthermore, since the areas with increased coupling are restricted to the perimeter of the sensor board, the coupling to unwanted noise sources is not increased unnecessarily.

Similar approaches are adopted for the $\sin X$, $\cos Y$ and $\sin Y$ coils illustrated in figures 7, 8 and 9 respectively.

In the case of the central portion of the $\cos Y$ coil illustrated in figure 8, the additional turns at the left and right hand edges are connected across the middle of the board. The conductors forming this connection are close together in the y direction so that the increase in coupling is minimised except near the left and right hand edges. In addition there is one loop of conductor both above and below this central connection region wound in the opposite sense, which is wound in the opposite direction to the main inner loop and serves to reduce coupling except at the left and right hand edges. This reduction in coupling in

the central region can alternatively be viewed as an increase in relative coupling near the sensor board's perimeter.

In figure 1, a resonator in the central region couples to portions of the x sensing coils both above and below the resonator in the y direction. However a resonator near the top edge of the sensor board couples only to the portion of the x sensing coils below. This lack of symmetry causes poor accuracy. The increased coupling near the sensor board perimeter achieved with the new sensor board design approach partially compensates for the missing coupling to coils above the resonator and yields an accuracy improvement.

4 ALTERNATIVE EMBODIMENTS

The approaches outlined in this document are equally applicable to GB 98/01759.

The approaches outlined in this document are equally applicable to sensor coil designs implemented on a 2 layer PCB, or PCBs with other numbers of layers. They are also appropriate for wire wound devices.

Although the description above was for pen input to mobile devices, the approach is equally applicable to other applications for position sensing in at least 2 dimensions.

The moving element may be a resonator as described above, but may also be a moving powered coil or a flux concentrator.

Figure 1

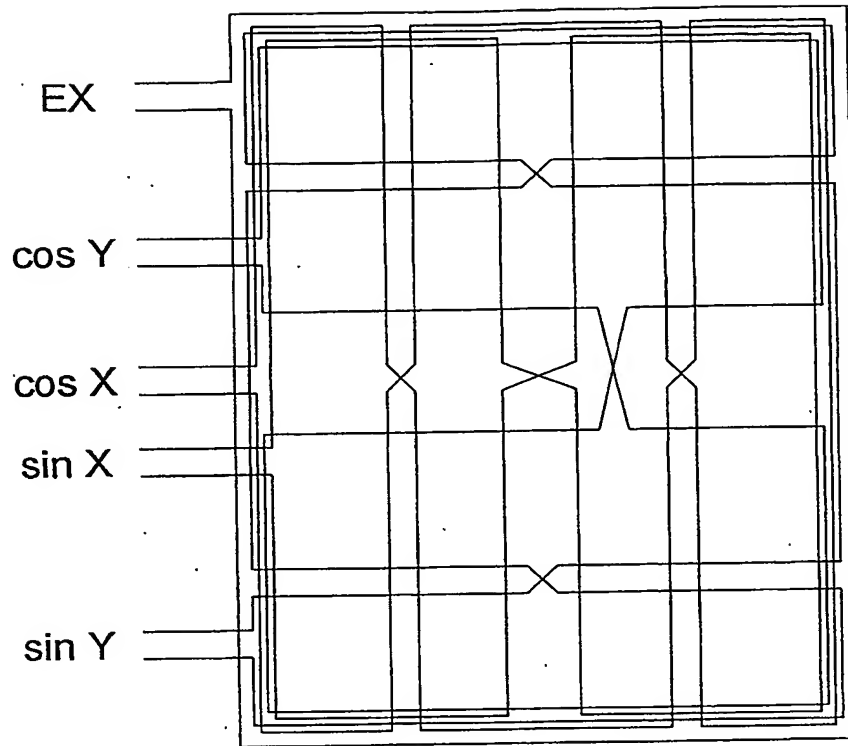


Figure 2

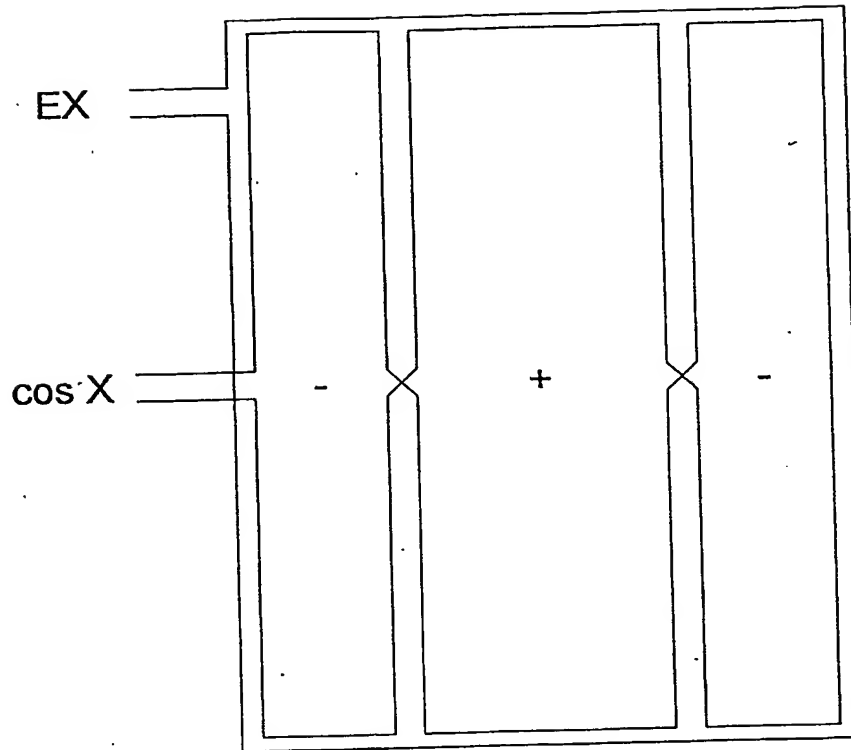
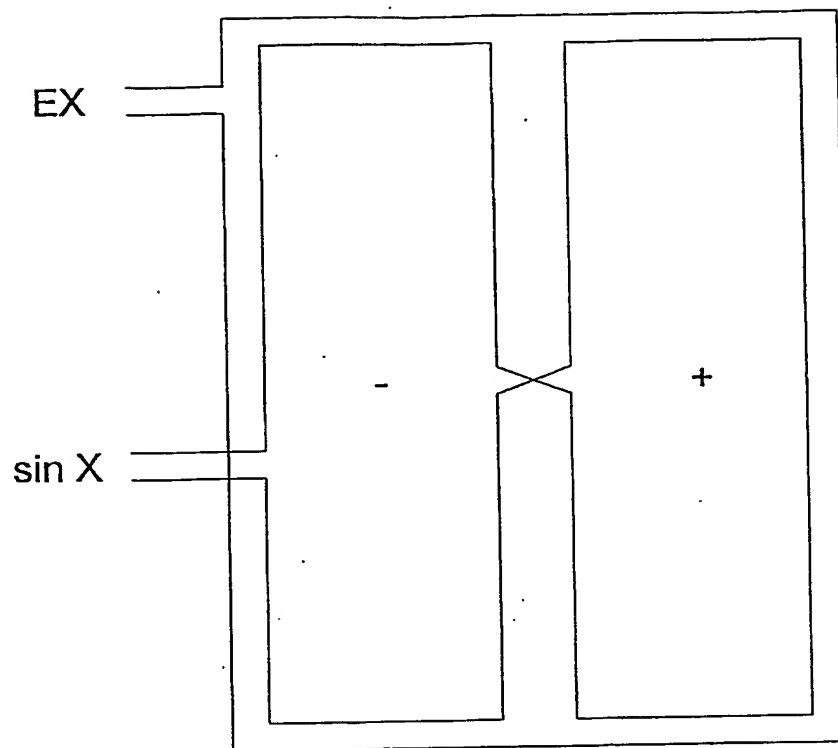
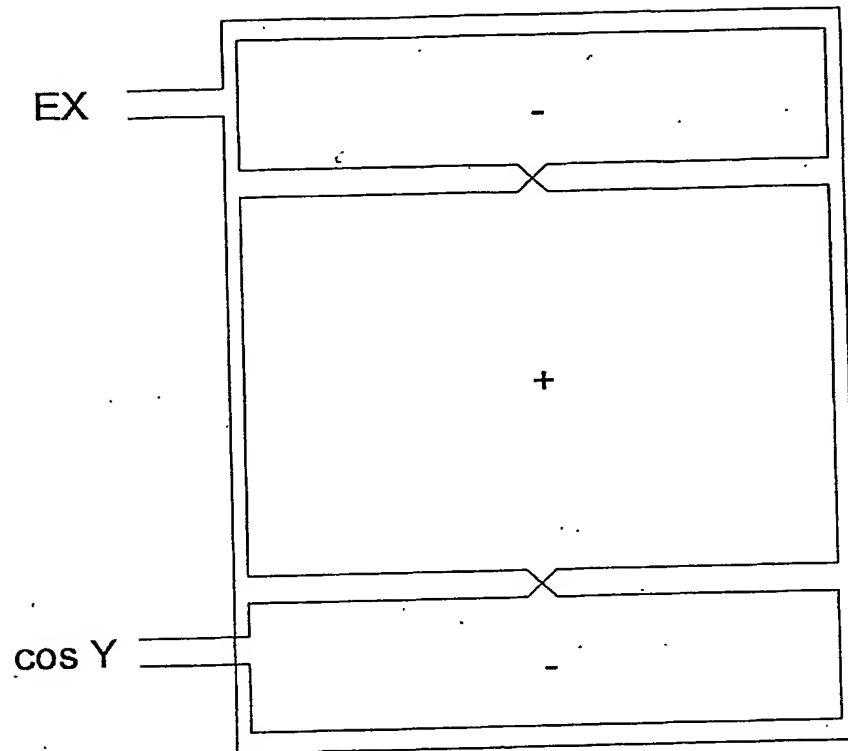


Figure 3



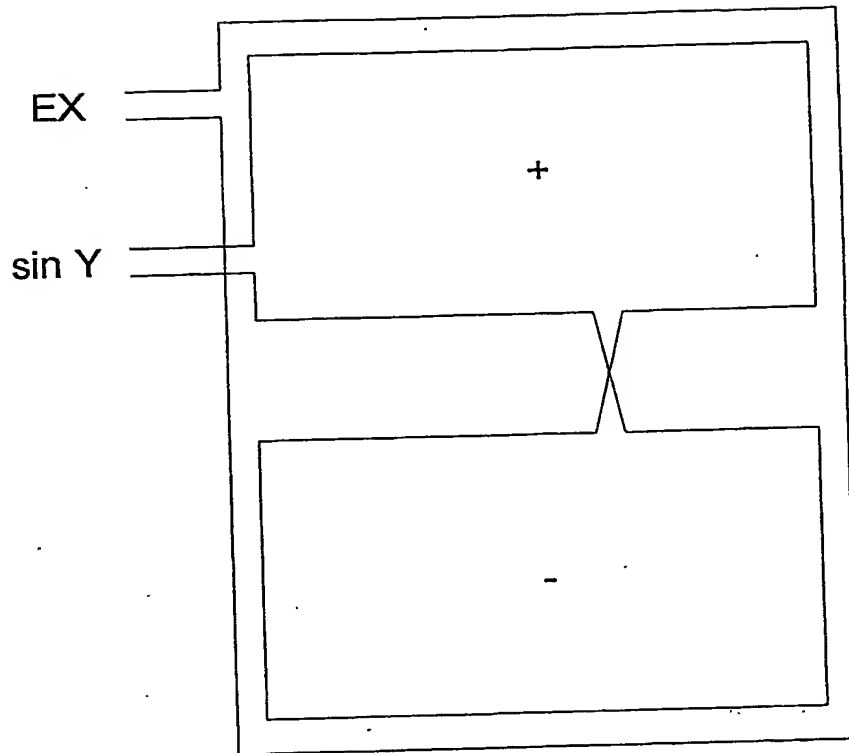
4/13

Figure 4



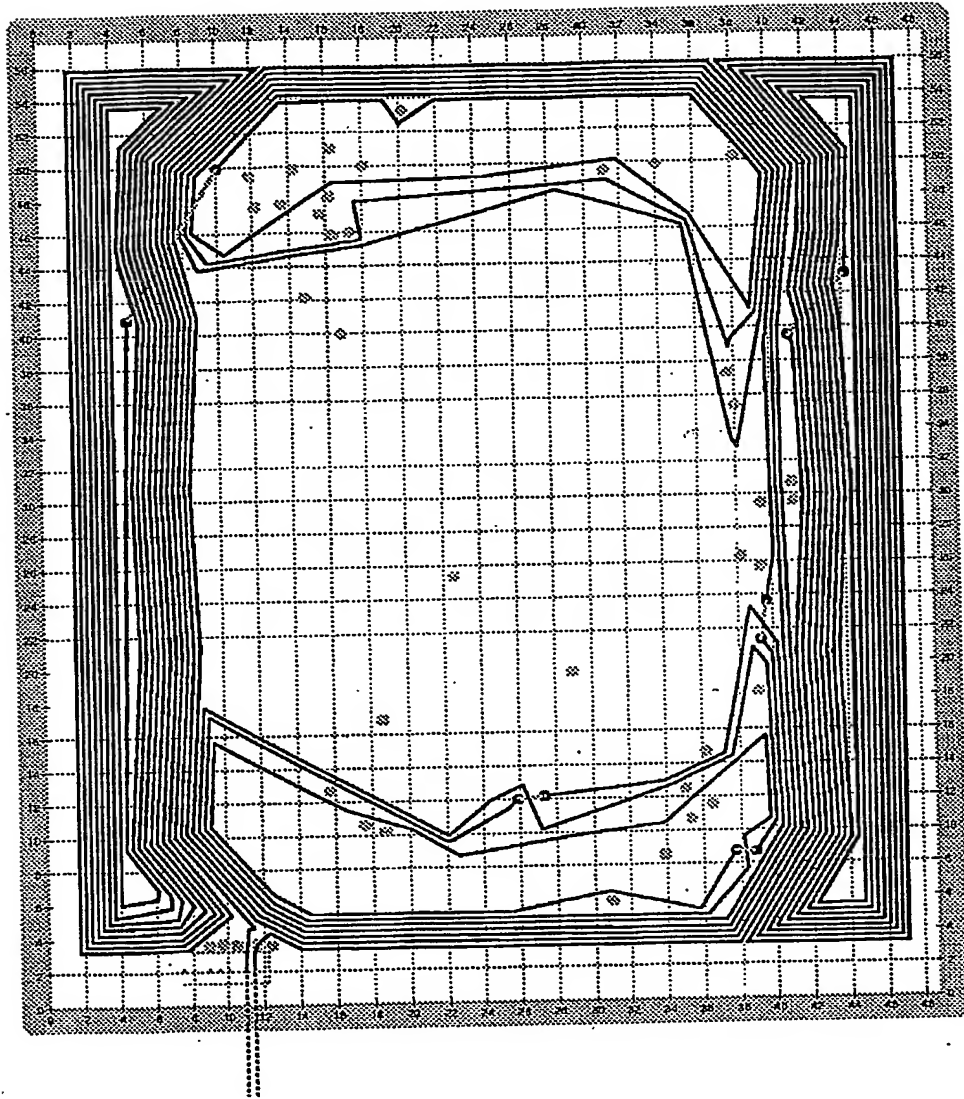
5/13

Figure 5



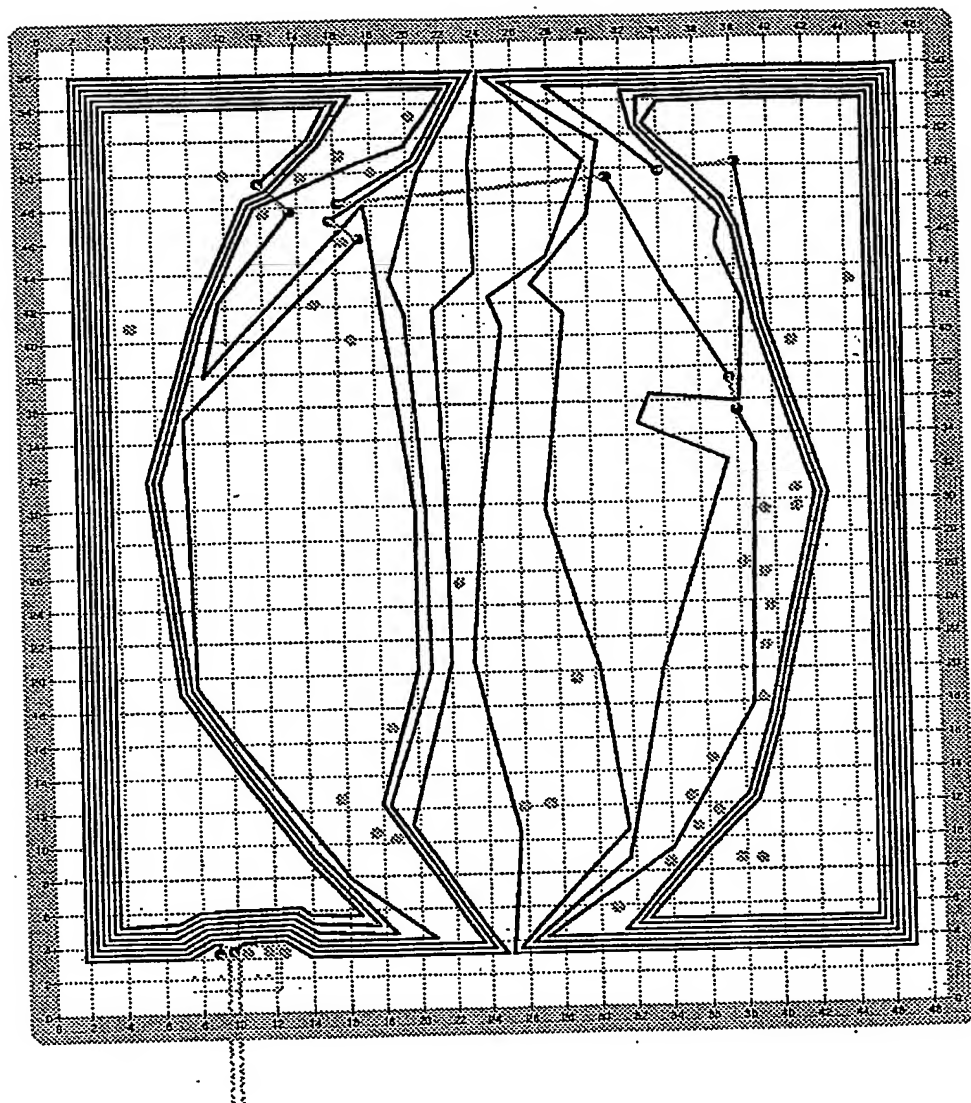
6/13

Figure 6



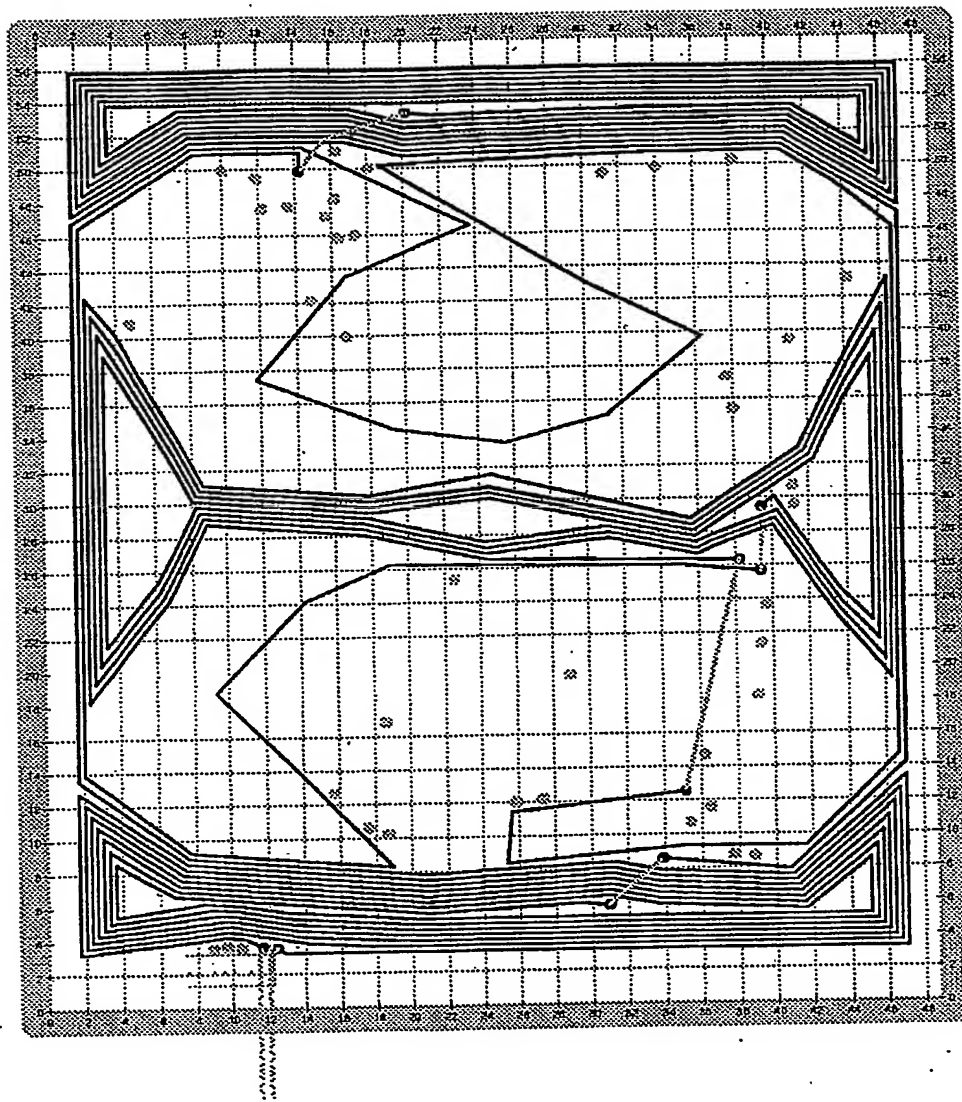
7/13

Figure 7



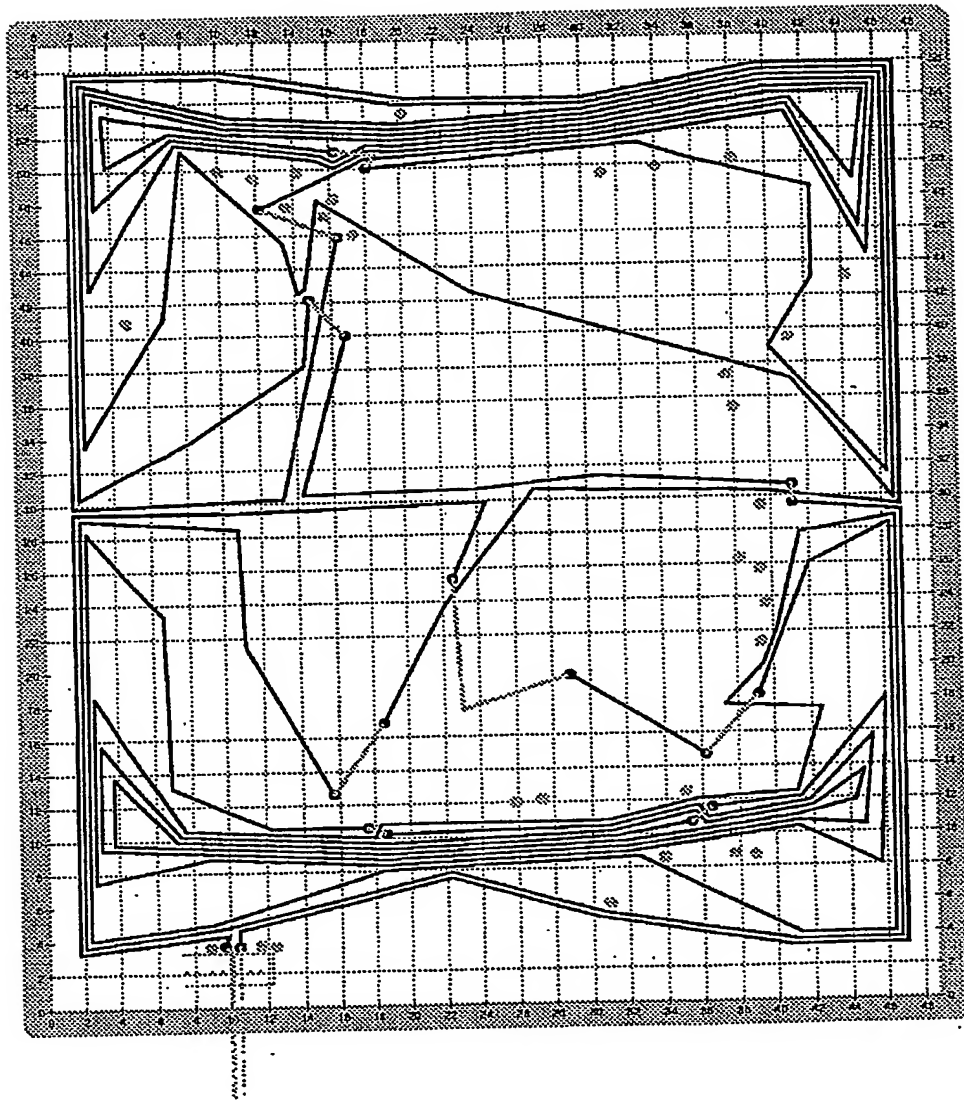
8/13

Figure 8



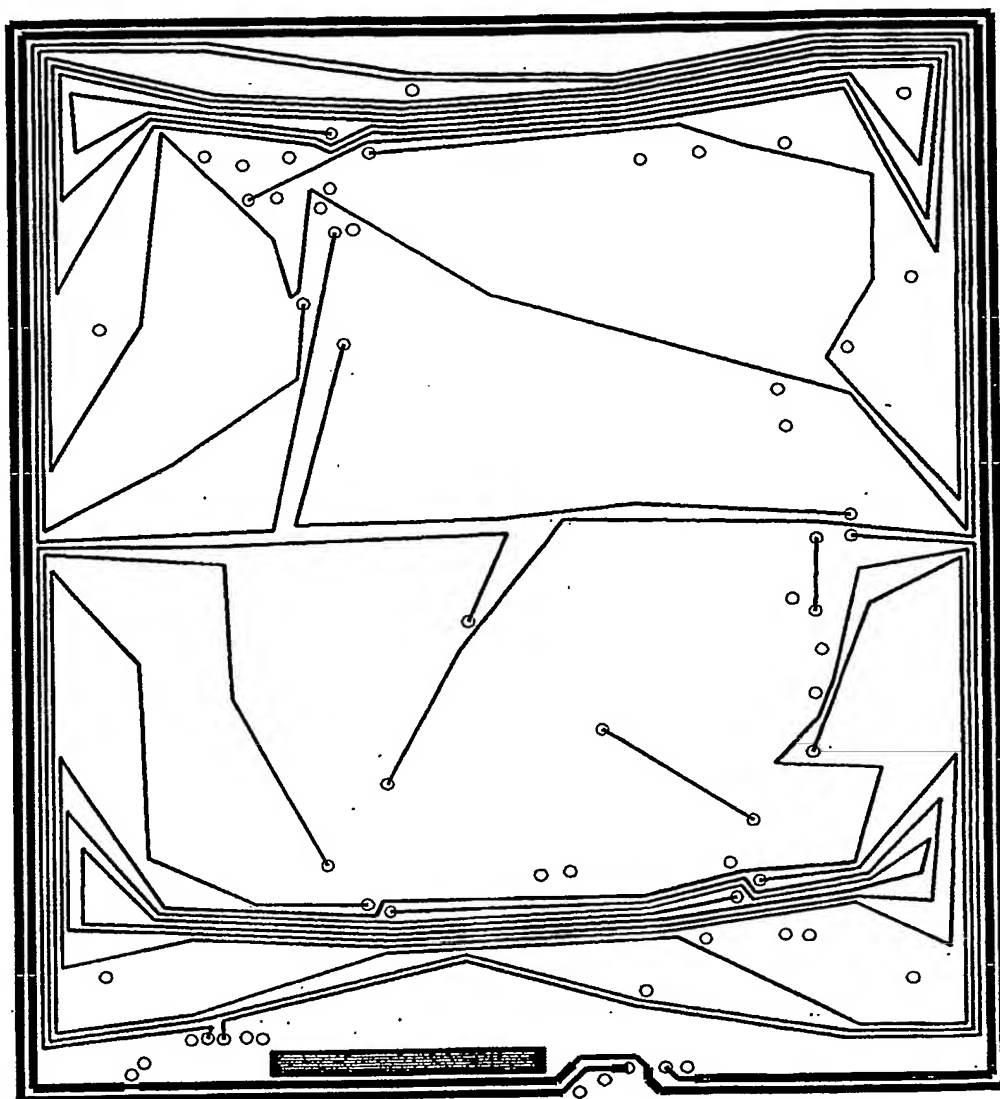
9/13

Figure 9



10/13

Figure 10



11/13

Figure 11

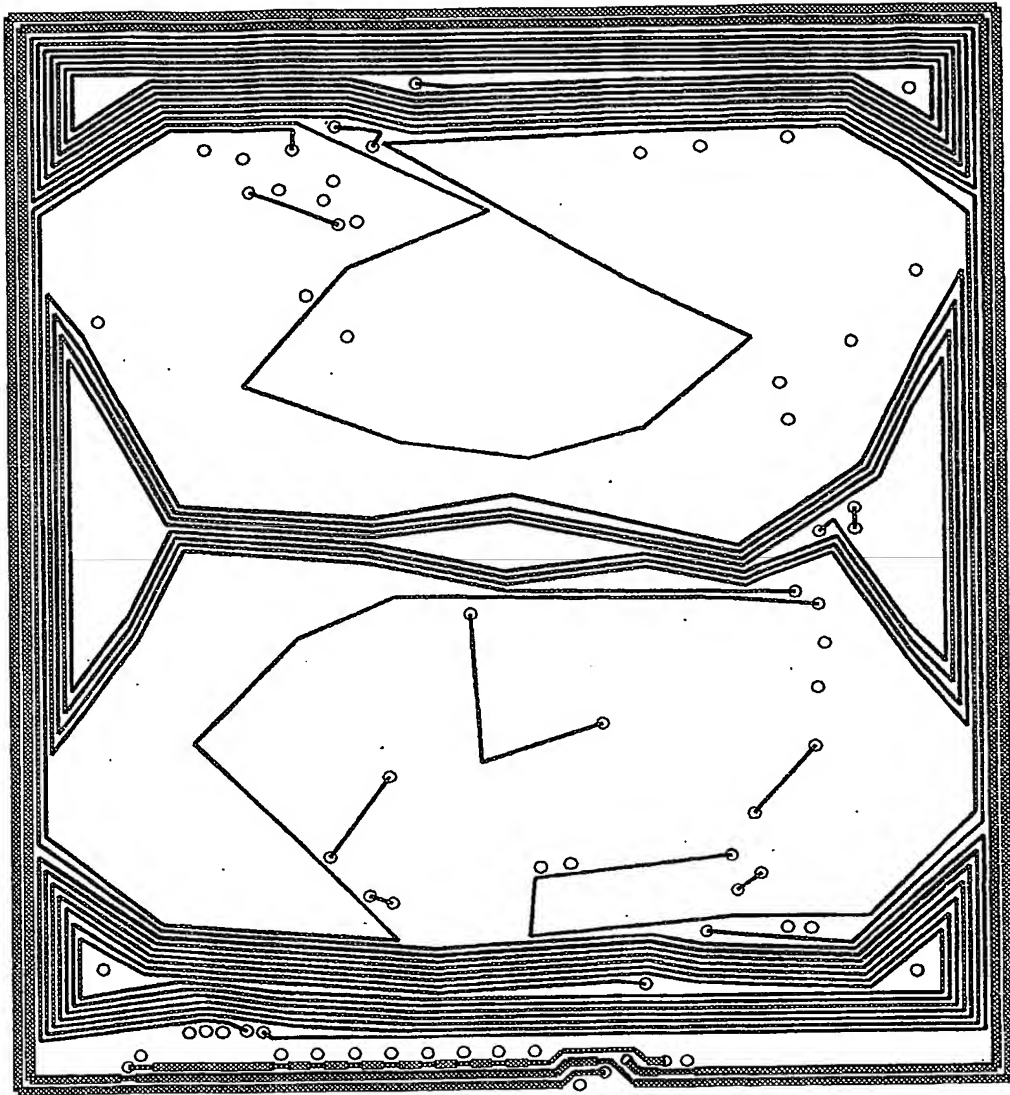


Figure 12

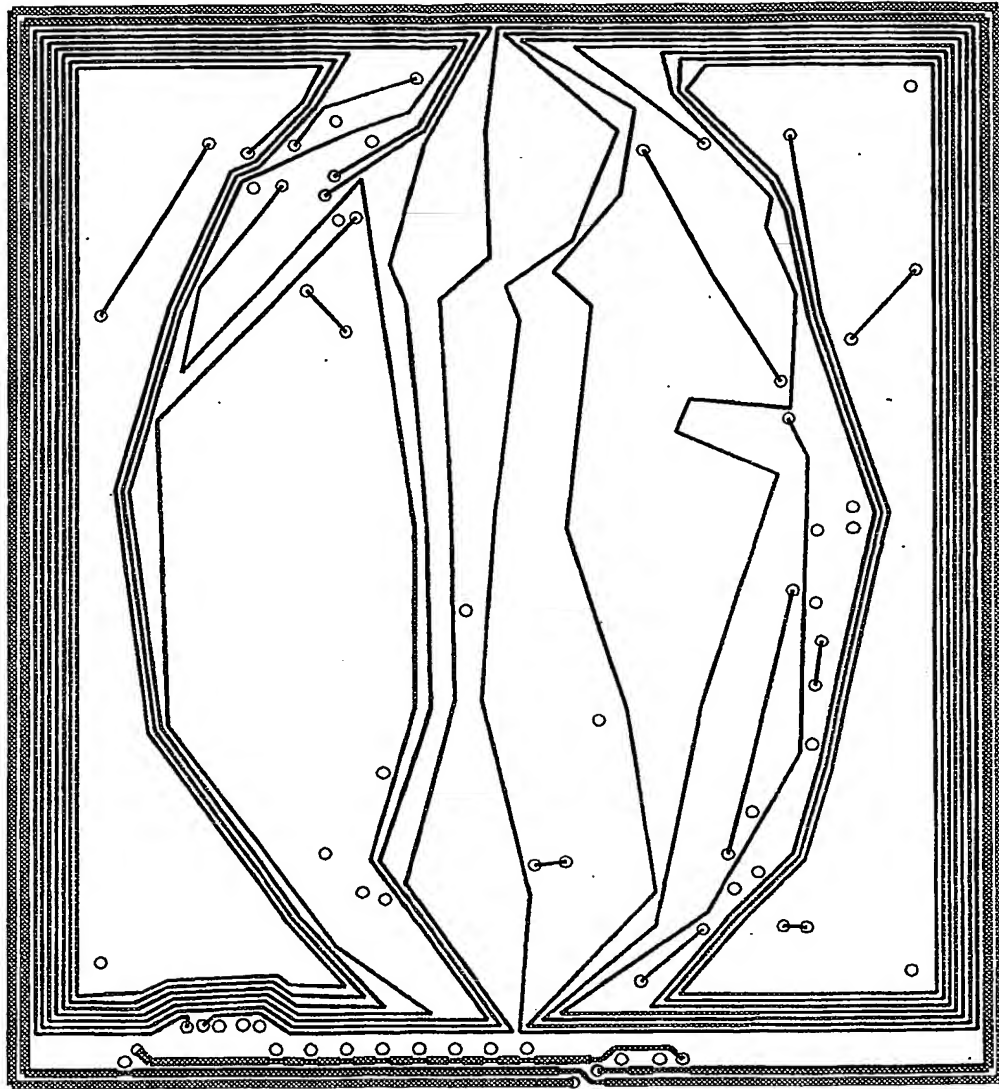
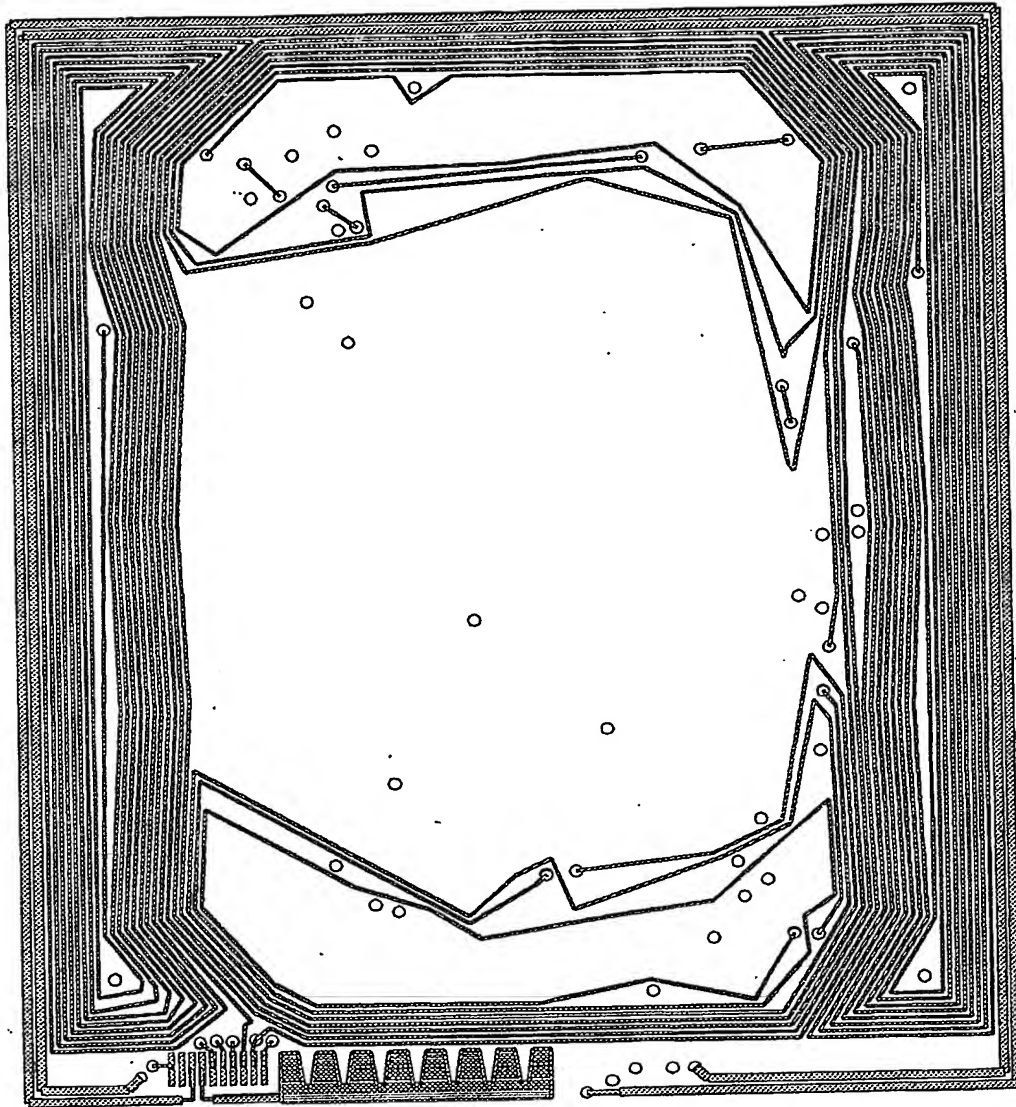


Figure 13



09 JAN 2003
Received in Patent
International Unit

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.